



Appalachian National Scenic Trail, Triple Crown Area Transit Feasibility Study *Final Report*



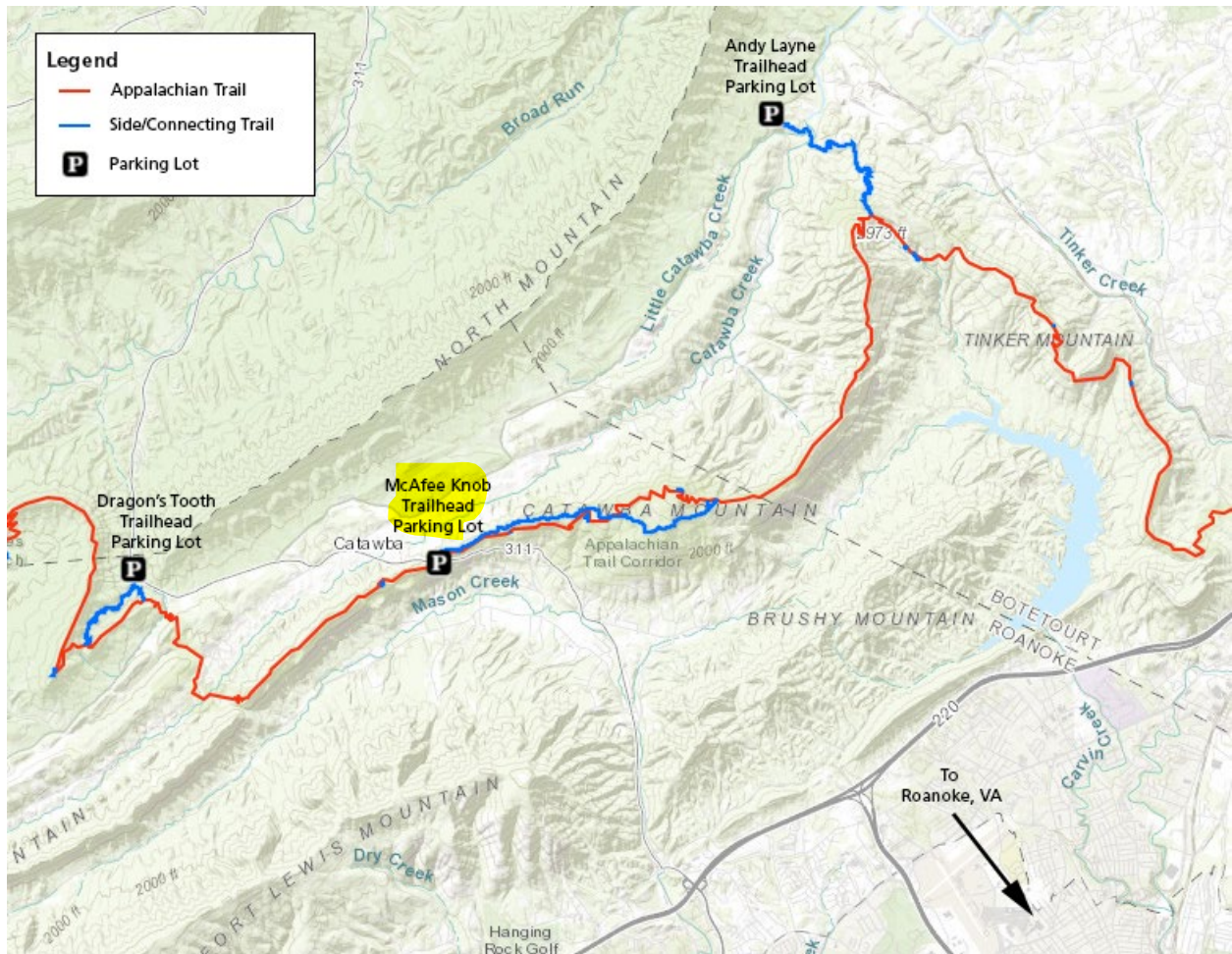
Catawba Mountain, Appalachian Trail, VA (Photo courtesy of Roanoke Appalachian Trail Club)



February 2021



Figure 2: Triple Crown Area of the Appalachian National Scenic Trail Map Inset



Source: Appalachian Trail Conservancy



Methodology

The project team analyzed parking lot and visitation data, existing infrastructure conditions at the trailhead parking lots, and incorporated input collected from stakeholder interviews to generate five shuttle service scenarios. For each scenario, the project team applied the methodology and assumptions outlined in this section to develop passenger ridership projections, ridership demand estimates, cost estimates, and an assessment of how well each scenario aligns with stakeholder goals.

Shuttle Scenario Development

To develop the shuttle service scenarios, the project team interviewed project stakeholders and engaged NPS and project partners to develop a list of goals for a potential shuttle service to achieve. Based on these interviews and discussions, the following goals were identified. The goals are not listed in any particular order and are intended to be used as an analytical tool to assess potential shuttle service scenarios.

- **Goal 1: Address acute parking demand and congestion challenges at McAfee Knob**
- **Goal 2: Disperse use across trailheads to improve visitor experience, visitor safety, and resource conditions along the Triple Crown trail segments**
- **Goal 3: Connect to other destinations in the region to provide easily accessible service to a greater number of people**
- **Goal 4: Provide a simple, easy-to-understand, and consistent service design for the public**

Recognizing that these goals represent a broad array of interests and that some goals are in tension with one another, the project team developed five total scenarios, each of which aligns with different aspects of these goals. The project team refined the shuttle scenarios through an iterative process with NPS and project partners. This process involved an online workshop with project partners, at which consensus was achieved on the range of route options and specific stops to prioritize in shuttle service scenarios.

The project team calculated route times and developed preliminary service schedules using several agreed-upon assumptions established through discussions with NPS and project partners. Both 20-minute and 30-minute service headways are evaluated for all shuttle service scenarios analyzed in this report. NPS and project partners consistently identified a preference for 20-minute headways to meet visitor expectations. A 30-minute headway is included in analysis for cost comparison purposes. A two-minute dwell time is assumed for each stop location.

Based on visitation analysis results in an earlier memo completed for this project,¹ the scenario analysis assumes that shuttles would operate 12 hours per day, on Fridays, Saturdays, and Sundays, between April and October (seven months). A 12-hour operating day is assumed for this analysis because lower levels of service would not sufficiently align with (1) visitation duration patterns and (2) limited shuttle capacity (see Passenger Ridership Projections and Ridership Demand Estimation below). Specifically, NPS staff and project partners indicated that the majority of visitors (85 percent) are day hikers, who take between six and eight hours to complete their hikes. Therefore, a shuttle service with fewer than 12 hours of service would not provide sufficient time to allow visitors to take the shuttle and complete their hikes in time to catch a return shuttle. While visitation to the Triple Crown area is slightly lower in July and

¹ U.S. DOT Volpe Center, *Appalachian National Scenic Trail, Triple Crown Area, Technical Memo 2: Existing Conditions*, September 2020.



August, a seven-month season of operation aligns with the primary peak visitation season and provides potential economies of scale for more cost-effective shuttle operations.

A common metric for bus transit service is the total person capacity of a transit bus, which is generally defined as the total number of passengers able to be on a bus at a given time for a bus to safely operate. For this analysis, the total person capacity of the vehicle is the number of seats on the vehicle, as it would not be safe to have standing passengers on mountainous highway routes. A high rate of passenger turnover (i.e., passengers only go one stop and get off) means the bus can carry more passengers over the course of the route. For this analysis, we assume that bus trips will *not* have high rates of turnover in the peak direction of travel.² Passengers will stay on the bus until they reach their desired trailhead, which in most cases will be McAfee Knob. Therefore, passenger capacity is the same for all scenarios, even with additional stops served.

Passenger Ridership Projections and Ridership Demand Estimation

The analysis does not have the benefit of ridership data from an existing service. Instead, the estimated demand for a Triple Crown shuttle is based on existing visitation data, experience from peer shuttle services in the NPS, and several agreed-upon assumptions established through discussions with NPS and project partners.

First, the analysis presented in this memo assumes no changes to current trailhead parking lot design and geometry at the Dragon's Tooth parking lot and the Andy Layne trailhead parking lot (used to access Tinker Cliffs). Buses and large shuttle vehicles cannot enter and exit these trailhead parking lots, and there is not adequate shoulder space for roadside boarding and alighting. As a result, the **shuttle capacity assumption used throughout this analysis is 12 passengers**. While design changes to the parking lots may be implemented in the future, it is beyond the scope of this memo to analyze these possibilities.

Second, passenger ridership projection calculations assume that every passenger will board the shuttle twice – once outbound to the trail and once back inbound to their point of origin (e.g., their car). As a result, the total number of riders is estimated to be half the total number of boardings. Because the shuttle service would represent new service, the project team did not have data upon which to predict rider behavior. To account for this, the analysis presents two possible ridership projections: a low-ridership projection and a high-ridership projection. The low-ridership projection assumes that every shuttle roundtrip departs in the peak direction with seven passengers (at 60 percent capacity). The high-ridership projection assumes that every shuttle roundtrip departs in the peak direction with 12 passengers (at 100 percent capacity).

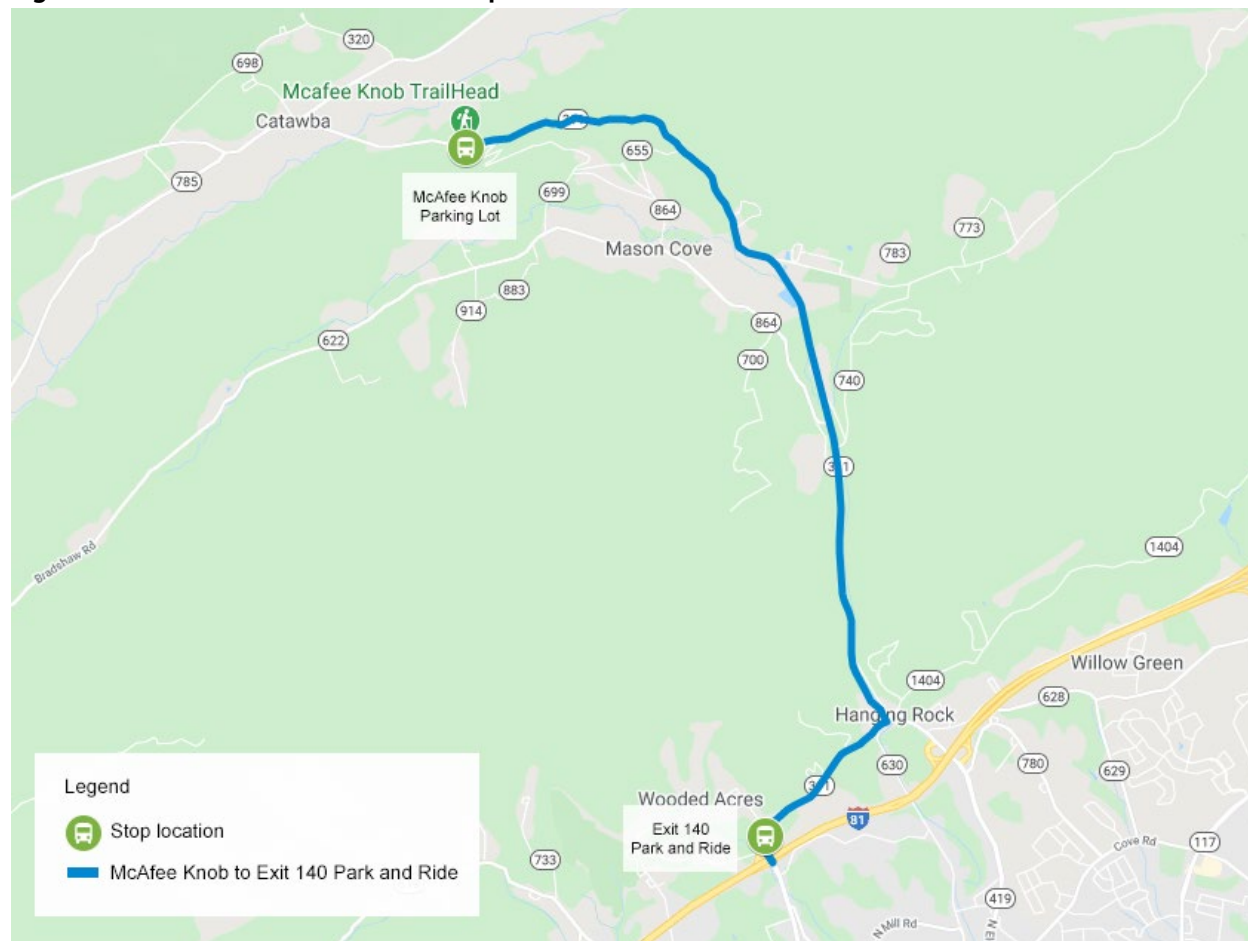
Third, ridership demand calculations associated with the McAfee Knob pedestrian bridge construction project are built upon prior analysis of observational parking lot count data. This data and analysis is explained in detail in an earlier memo developed for this project.³ The ridership demand analysis for McAfee Knob assumes that half of the parking lot spaces will be unavailable during pedestrian bridge construction; reducing the 75 available parking spaces to 37 spaces during construction. Consistent with

² The peak direction of travel refers to the direction of travel when ridership is highest by the time of day. The morning peak direction of travel for the Triple Crown area is outbound toward the trailheads. The peak direction switches to inbound in the afternoon as hikers return to the origin of their trip (e.g., their car).

³ U.S. DOT Volpe Center, *Appalachian National Scenic Trail, Triple Crown Area, Technical Memo 2: Existing Conditions*, September 2020.

Baseline Service: Exit 140 Park-and-Ride Lot to McAfee Knob

Figure 4: Baseline Service Scenario Map



Source: Volpe Center / Google Maps

Service Design

The baseline service scenario provides direct service from the Exit 140 park-and-ride lot to the McAfee Knob trailhead parking lot. NPS and project stakeholders identified this baseline service as the most critical segment for a possible shuttle service given the high visitation demand experienced at McAfee Knob and the pending closure of half of the parking lot. A map of this service scenario is shown in Figure 4.

The baseline service scenario would provide service from the Exit 140 park-and-ride lot on Edgebrook Road. The shuttle would turn right out of the lot and travel north on Edgebrook Road. It would then turn right onto Mountain Heights Drive before turning left onto VA-311 (Thompson Memorial Drive), which is an unsignalized intersection. The shuttle would continue on VA-311, turning left at its junction with Route 419 onto Catawba Valley Drive. The shuttle would turn left into the McAfee Knob parking lot to drop off passengers. The return route would follow the same path in reverse. A specific shuttle stop location would need to be designated in the McAfee Knob parking lot. The stop should be placed where the shuttle can safely let off passengers and be able to turn around without excessive maneuvers. Parking in the shuttle stop and turnaround path must be prohibited and enforced to ensure the shuttle can



successfully navigate the parking area and complete a turnaround. Unauthorized parking that blocks the shuttles path can result in schedule delays and potentially unsafe conditions for passengers to get on or off the vehicle.

A one-way trip under this shuttle service scenario would take approximately 12 minutes. Assuming a two-minute dwell time at each stop, a complete roundtrip would take approximately 24 minutes. Scenario service details are summarized in Table 1.

Table 1: Baseline Service Scenario Detail





Characteristic	Measure
Shuttle stop count	2 stops
One-way total time and mileage	12 minutes, 7 miles
Round trip total time and mileage	24 minutes, 14 miles
Dwell time per stop	2 minutes




Source: Volpe Center

Goal Alignment

This scenario provides service to one trailhead parking lot, serves two stops, and has a roundtrip total time of 24 minutes. Based on these service characteristics, this scenario achieves goals one and four and does not achieve goals two and three. The alignment of this scenario with shuttle service goals is shown in Figure 5.

Figure 5: Assessment of Goal Alignment for Baseline Service Scenario

-  **GOAL 1:** Address acute parking demand and congestion challenges at McAfee Knob
-  **GOAL 2:** Disperse use across trailheads to improve visitor experience, visitor safety, and resource conditions along the Triple Crown trail segments
-  **GOAL 3:** Connect to other destinations in the region to provide easily accessible service to a greater number of people
-  **GOAL 4:** Provide a simple, easy-to-understand, and consistent service design for the public

Legend:  Achieves goal  Somewhat achieves goal  Does not achieve goal

Cost Estimation

Under this shuttle service scenario, costs are estimated to be between \$161,280 and \$201,600 annually for a service with 20-minute headways, and between \$80,640 and \$100,800 annually for a service with 30-minute headways. These estimates are summarized in Table 2.



Table 2: Baseline Service Ridership and Cost Estimates

SCENARIO: Baseline Service		
Headway	20 minutes	30 minutes
No. of Shuttle Vehicles Required	2 vehicles	1 vehicle
Total Cost	\$161,280–\$201,600	\$80,640–\$100,800
Low-Ridership Projection		
One-way Cost Per Rider	\$7.41–\$9.27	\$5.49–\$6.86
Roundtrip Cost Per Rider	\$14.83–\$18.53	\$10.97–\$13.71
Total Rides Per Day	260	176
Riders Per Day	130	88
Annual Ridership	10,920	7,392
High-Ridership Projection		
One-way Cost Per Rider	\$4.32–\$5.41	\$3.20–\$4.00
Roundtrip Cost Per Rider	\$8.65–\$10.81	\$6.40–\$8.00
Total Rides Per Day	440	300
Riders Per Day	220	150
Annual Ridership	18,650	12,600

Source: Volpe Center



Business Models

The NPS has a few different operation models for shuttle service within parks. These include concession contracts, service contracts, cooperative agreements, park-owned and operated, special use permits (SUPs), and commercial use authorizations (CUAs). As the Appalachian National Scenic Trail is unique in scale and structure as an NPS park unit, it does not have the capacity to operate its own service or manage contracts or agreements and commercial use is not allowed on the trail per its Comprehensive Management Plan. Therefore, a trailhead shuttle service in the Triple Crown area could only be feasible using an SUP with a non-profit organization, government agency, or an experienced operator and a partner to serve as the manager for the service. The features of an SUP are shown in Table 11. Additionally, because the Dragon’s Tooth trailhead parking lot is owned by the U.S. Forest Service, an additional SUP issued by the U.S. Forest Service would be required for shuttle service to operate for scenarios where service is extended to Dragon’s Tooth.

Table 11: Special Use Permit Features

Feature	Special Use Permit (SUP)
Operator Type	Non-profit organization or government agency
Purpose of Service	Provide a transportation service but not one required by NPS; the focus is on providing transportation, not generating profit
Timeframe	Up to five years, maximum
Revenue	Does not generate revenue; can only cover operating costs
Fees Charge by NPS	Up to cost recovery, but may be waived based on park discretion
Fares Charged to Passengers	Able to charge a modest fare for cost recovery, but may not generate profit
Level of NPS Control	Limited; can only establish a maximum level of service, not a minimum; Location

Source: Volpe Center interview with NPS Region 1 Permits Manager

A local government agency or non-profit in the area may have the ability to manage a contract or agreement with a shuttle operator. If a local government or non-profit were to engage in an arrangement to provide shuttle service, the park would execute an SUP with the managing organization, not the operator. It is unclear what contracting options are available to a local government agency or non-profit to engage a transit operator for the service, and it is beyond the scope of this project to determine how that relationship could be structured.



Analysis

McAfee Knob Pedestrian Bridge Construction Impacts

As noted in the Project Purpose section of this report, the construction of the pedestrian bridge at the McAfee Knob parking lot provides a unique opportunity to pilot shuttle service as a way to address visitation demand and issues related to parking congestion. Because the pedestrian bridge construction will involve the closure of half of the McAfee Knob parking lot, visitors who would typically park in the lot but will be unable to do so due to the parking capacity reduction represent a potential source of shuttle ridership demand. This section uses available data to estimate the level of demand that visitors displaced by the partial parking lot closure represent among potential shuttle riders.

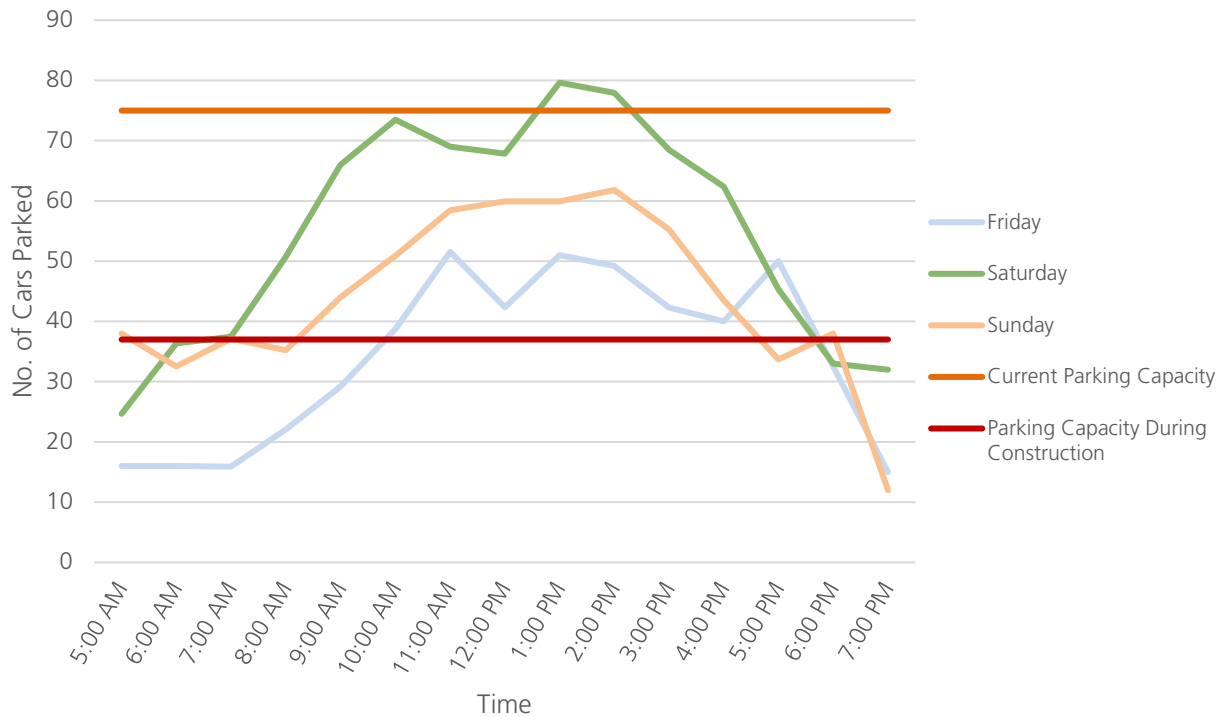
It is important to note that these displaced visitors represent only *one* source of potential ridership demand, especially for shuttle service scenarios involving shuttle service to multiple trailheads. The analysis presented here is designed to illustrate how well a potential shuttle service would meet a *minimal level of demand*, represented by visitors displaced by the partial parking lot closure at McAfee Knob.

The project team identified the 85th percentile of parking lot usage in Ridgerunner data from 2017 through 2019. The 85th percentile day represents a typical busy day and is a methodology used commonly used in visitor use management analysis.⁵ Using this data, the project team calculated the average number of cars observed in the McAfee Knob parking lot on a typical busy day by hour, for each day of proposed shuttle service (Friday, Saturday, and Sunday). Figure 14 shows these averages, compared with the current parking lot capacity (75 cars, indicated by an orange line) and the reduced parking lot capacity during construction (37 cars, or half of the current capacity, indicated by a red line). **Notably, the average number of cars observed in the parking lot exceeds the construction reduced capacity for the majority of daytime hours for all three days – between 10:00 AM and 5:00 PM on Fridays, 7:00 AM and 5:00 PM on Saturdays, and 10:00 AM and 4:00 PM on Sundays.**

⁵ The 85th percentile methodology used here, as well as additional information about the Ridgerunner data used for this analysis, is described in detail in an earlier memo written as a part of this project. See: U.S. DOT Volpe Center, *Appalachian National Scenic Trail, Triple Crown Area, Technical Memo 2: Existing Conditions*, September 2020.



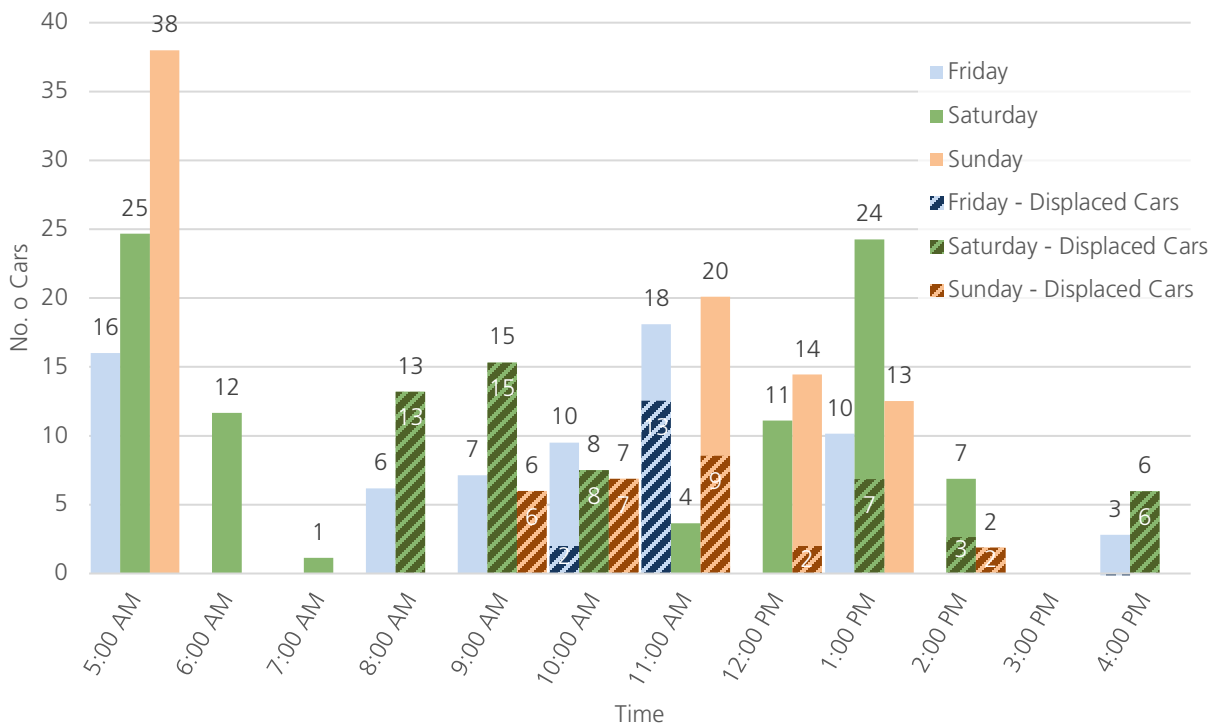
Figure 14: Average Number of Cars Parked at McAfee Knob on a Typical Busy Day by Time of Day (2017-2019)



The project team applied a duration analysis to the average number of cars parked by time of day to estimate cars arriving at the parking lot by hour. The analysis is based on the assumption that all day visitors take between six and eight hours to complete their hike, as do the majority of visitors (85 percent) completing day hikes. The project team then calculated the average number of cars displaced by hour as a result of the reduced parking lot capacity during construction. Figure 15 shows the average number of new cars arriving at the parking lot by hour for each day of potential shuttle service. Overlaid on these averages, shown with dark diagonal shading, is the number of arriving cars that would be displaced by the reduced parking lot capacity; that is, these cars currently find a parking space, but will not find an available parking space when the parking lot capacity is reduced during construction. For example, 25 cars arrive at the lot at 5:00 AM on a typical Saturday. Another 12 arrive during the 6:00 AM hour for a total of 37 cars (assuming none of the cars parked at 5:00 AM have left). One additional car arrives and parks in the 7:00 AM hour. Another 13 cars would usually arrive at the parking lot in the 8:00 AM hour; however, there are no available parking spaces and the 13 are displaced from trailhead parking. In the 1:00 PM hour, of the 24 cars that arrive at the parking lot, seven are displaced. As Figure 15 illustrates, on typical busy weekend days, some portion of cars would be displaced between 8:00 AM and 2:00 PM.



Figure 15: Average Number of Cars Arriving at McAfee Knob and Displaced by Parking Lot Capacity Reduction on a Typical Busy Day, by Hour



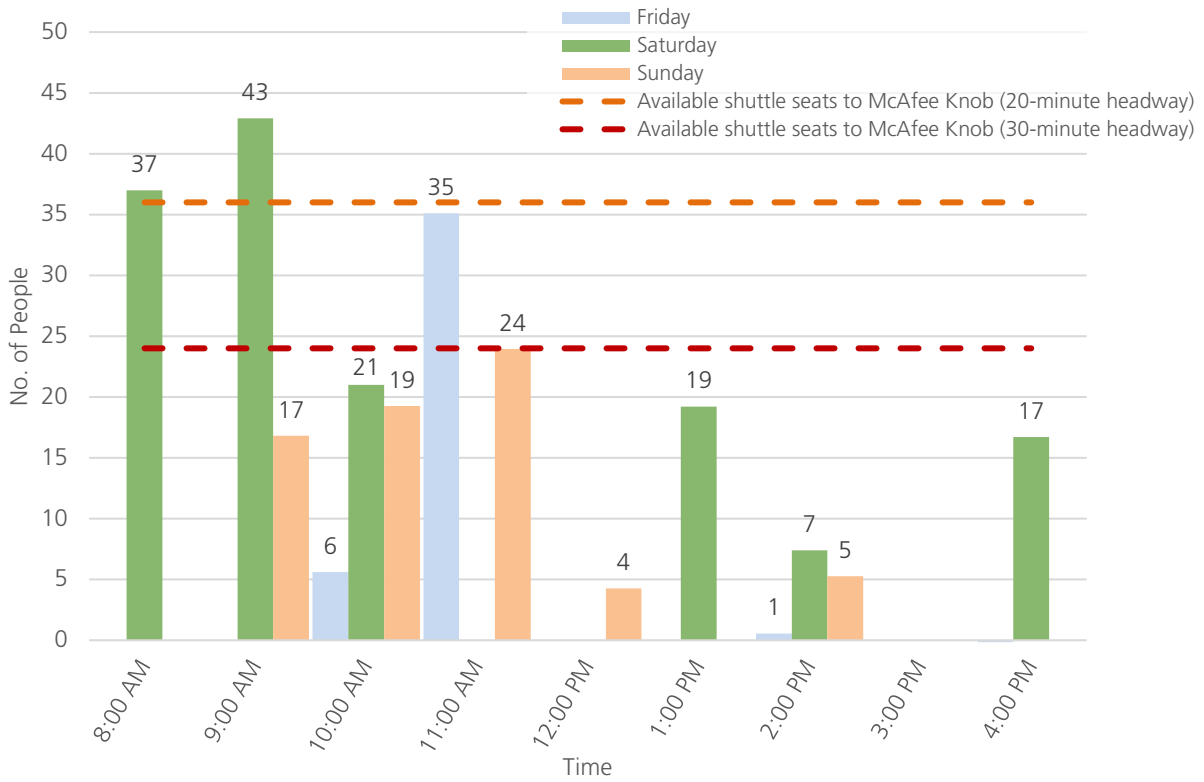
Notes: Columns are not shown when the average number of cars arriving during an hour is zero. Averages for 5:00 PM through 7:00 PM are not shown, as the average number of cars arriving for all days during these hours is zero.

With the average number of cars displaced identified, the project team calculated the average number of visitors displaced from arriving by car to McAfee Knob using the persons per vehicle multiplier of 2.8.⁶ This represents the visitors that would make up one source of potential ridership demand for a shuttle service. Figure 16 shows the estimated number of displaced visitors by hour and day, compared to the maximum number of seats available on shuttle service to McAfee Knob from the Exit 140 park-and-ride lot. The dashed orange and red lines across the chart represent total available shuttle seating at 20- and 30-minute service headways, respectively. As this figure illustrates, ridership demand from displaced visitors to McAfee Knob alone exceeds available seats over the entire hour on a typical busy Saturday at 8:00 AM and 9:00 AM under both 20- and 30-minute headways, and ridership demand on a typical busy Friday at 11:00 AM exceeds available seats under a 30-minute headway scenario.

⁶ Because the NPS has not calculated a persons per vehicle measure for the AT, the project team used a persons per vehicle estimate of 2.8, consistent with the measure for the two nearest park units to the Triple Crown (the Blue Ridge Parkway and Great Smoky Mountains National Park). See: National Park Service, *Blue Ridge Parkway Public Use Counting and Reporting Instructions*, January 2003, <https://irma.nps.gov/STATS/FileDownload/190>, and *Great Smoky Mountains National Park Public Use Counting and Reporting Instructions*, January 2016, <https://irma.nps.gov/STATS/FileDownload/1261>.



Figure 16: Estimated Average Number of Visitors Displaced by Parking Capacity Reduction on a Typical Busy Day at McAfee Knob



Notes: Columns are not shown when the estimated average number of visitors displaced during an hour is zero. Estimated averages for 5:00 AM through 7:00 AM and 5:00 PM through 7:00 PM are not shown, as the estimated average number of visitors displaced for all days during these hours is zero.

This analysis has limitations. It is based upon observational data collected between 2017 and 2019, is based upon the average busiest days, only analyzes McAfee Knob visits, does not account for potential changes to visitation patterns, and does not account for return shuttle trips. However, even accounting for these limitations, this analysis shows that providing sufficient service to meet even estimated minimal demand on typical busy days will be challenging due to the small shuttle capacities required as a result of the challenging geometry of trailhead parking lots.



Key Findings and Recommendations

Based upon the analysis presented in this memo and the preceding memos associated with this feasibility assessment, the project team identified the following key findings and recommendations.

Due to trailhead parking lot geometry constraints and the area’s geography, a shuttle service is not well-suited to dispersing use across trailheads or providing connections to other tourist destinations in the region.

Of the four goals identified by NPS staff and project partners for a potential shuttle service to achieve, goals two and three (see below) are unlikely to be achieved by a shuttle service. The four goals identified by NPS staff and project partners are:

- **Goal 1:** Address acute parking demand and congestion challenges at McAfee Knob
- **Goal 2:** Disperse use across trailheads to improve visitor experience, visitor safety, and resource conditions along the Triple Crown trail segments
- **Goal 3:** Connect to other destinations in the region to provide easily accessible service to a greater number of people
- **Goal 4:** Provide a simple, easy-to-understand, and consistent service design for the public

Goals two and three are not well-aligned with a shuttle service for several reasons. First, the small shuttle capacity required to service the existing parking lots’ geometry greatly limits the ability to move visitors from a centralized parking lot to multiple trailhead destinations. Second, the area’s geography—with potential parking locations centralized near the more urban areas of the region and the destinations centralized in the mountains—does not provide for a high-level of passenger turnover across stops. Combined, these realities greatly limit the ability of a shuttle service to achieve goals two and three. However, goals one and four are met by all options examined in this report, with the exception of the loop service of scenario four.

Longer shuttle service scenarios with more stops increase costs without increasing the potential number of passengers served.

Because of the expected visitation patterns of Triple Crown area visitors using a shuttle—that is, the pattern of parking at a remote lot, taking a shuttle to a trailhead, completing an out-and-back hike, and taking a shuttle back to the parking lot—running longer shuttle service routes and serving more stops does not increase the potential number of passengers served. This is due to the fact that visitors are unlikely to complete certain segments as trips along a route. For example, visitors have little reason to travel between trailheads, even though these trip segments would be necessary to connect visitors to multiple trailhead destinations on a single shuttle route. Given that McAfee Knob has the highest visitation demand currently, the majority of visitors parking at the Exit 140 park-and-ride lot to board a shuttle are expected to alight at McAfee Knob, leaving little capacity to serve passengers to other trailhead stops. The result of these combined limitations is that the cost of the service increases with more stops and longer routes, but does not increase access due to the limited passenger capacity and visitation patterns. Therefore, the project team does not recommend implementing scenarios two, three, or four.



Piloting a shuttle service between the Exit 140 park-and-ride lot and McAfee Knob parking lot could fill data gaps for future analysis.

The partial closure of the McAfee Knob parking lot due to the pedestrian bridge construction presents a unique opportunity to pilot a shuttle service and to collect much-needed data to fill information gaps and allow for further analysis. This project was limited by the lack of data on visitation patterns (e.g., use of the Dragon's Tooth and Andy Layne parking lots; arrival, departure, and duration data at the parking lots) and ridership given that no current transit service exists for the Triple Crown area. Collecting data on a pilot service to fill these gaps could aid in completing further and more complex analyses of shuttle service options for the Triple Crown area. **The project team would recommend implementing the baseline service scenario for a pilot given its simplicity and low cost relative to the other scenarios evaluated in this report.**

Conclusion

This report documents the analysis of five possible shuttle service scenarios for the Triple Crown area of the A.T. through the development of preliminary shuttle service schedules, passenger capacity and ridership demand estimates, and cost estimates to help determine whether a shuttle service is feasible. The potential for shuttle service is primarily restricted by the existing parking lot geometries at the trailhead locations and the associated small shuttle capacity required in order to service these locations.

The long duration of stay for approximately 85 percent of day visitors also influences shuttle service operations. **Shuttles need to operate long service hours daily so that visitors using the service to access trailheads are able to return to their cars. Visitors will avoid using the shuttle if they feel they do not have a reliable way to return from the trail.** This long minimum service duration increases operating costs. The least expensive scenario is the baseline service option, which will cost a minimum of about \$80,000 per year and does not meet two of the four service goals.

Enforcement of parking restrictions at the trailhead lots is critical to the success of the shuttle. If a shuttle is blocked from accessing the designated stop by parked cars, the passengers cannot safely get on or off of the bus. Adequate enforcement will be needed at all shuttle stops to ensure the vehicle can pull up to its designated space, at least for the immediate rollout and some time period after. At the time of this analysis, NPS and USFS resources for enforcement was limited and sometimes required support from RATC volunteers and local law enforcement to manage parking and prevent lots from excessive parking. More enforcement will require additional resources, such as funding, staff, and volunteers.

Since there is not currently a shuttle system to access the Triple Crown area, public awareness and education about the service is also essential. The ATC and RATC have substantial local networks to facilitate distributing information. Roadside signage would help direct visitors to the park-and-ride lots to get on the shuttle and would also represent an additional cost to support the shuttle service. Increased outreach on social media and the park's and partners' websites will help inform the public about the shuttle service.

The purpose of this analysis was to examine the feasibility of operating a shuttle service to one or more of the trailheads that make up the Triple Crown of the A.T. in Virginia. The analysis informs an ongoing VUM Plan being developed by the NPS DSC Planning Division.

Based on the results of this analysis, the feasibility of a shuttle service for the Triple Crown area is mixed. **Shuttle service between the Exit 140 park-and-ride lot and McAfee Knob in response to reduced parking**



capacity from the pedestrian bridge project has the lowest cost per passenger at 30-minute headways, the simplest structure, and the fewest infrastructure challenges. The other scenarios have substantially higher costs than the baseline service scenario and do not appear feasible at this time given the constraints identified in this analysis.

Going forward, the park and its partners would likely benefit from focusing on data collection and analysis of a pilot baseline service scenario operation. As the broader VUM effort for the area advances, it may identify the potential for new and different visitation patterns that would increase the demand for a shuttle service, such as one-way hikes. If such visitation patterns are identified and additional information and data are collected from a baseline service scenario pilot, expanding service to include the Dragon's Tooth parking lot (as in scenario one), could be an additional next step for further data collection and analysis, with particular focus on the prevalence of new and different visitation patterns. For a larger and longer-term shuttle service to the Dragon's Tooth trailhead parking lot and to the Andy Layne trailhead parking lot that serves Tinker Cliffs to be feasible in terms of cost-efficiency and sufficient ridership, consideration of modifications to the parking areas at these locations would be required in order to increase the potential passenger capacity of a shuttle service.



Appalachian National Scenic Trail, Triple Crown Area

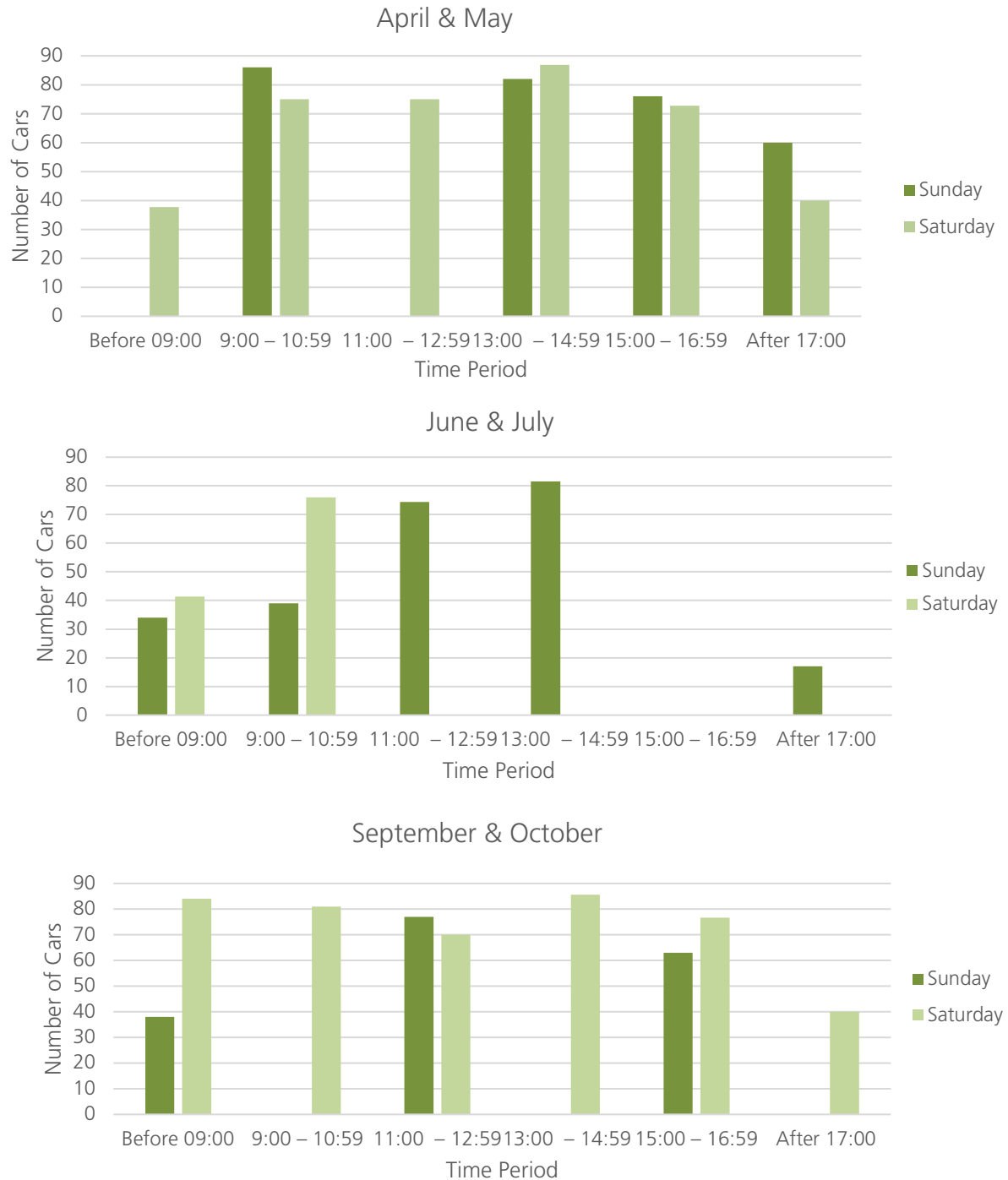
Appendix 2: Existing Conditions



September 2020



Figure 11: McAfee Knob 85th Percentile Parking Lot Usage on Weekend Days by Time of Day by Month



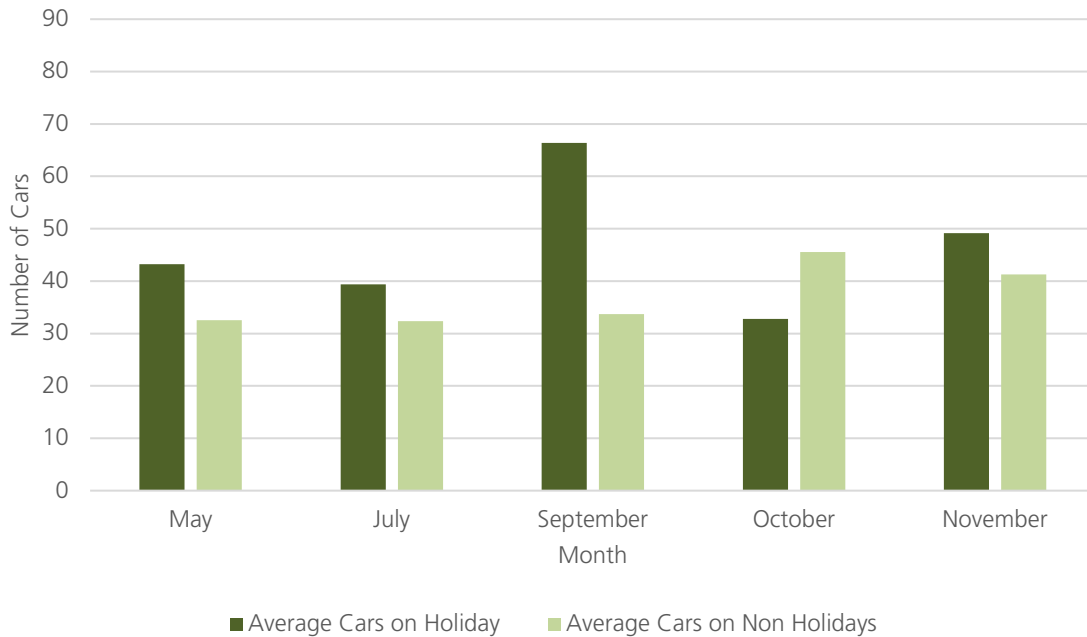
Source: Volpe Center analysis of Ridgerunner report data

Note: Time periods shown here with zero cars are a reflection of limited data availability and may not reflect a true 85th percentile value of zero.



The project team also specifically analyzed usage data on federal holidays to better understand how these days affect parking lot demand and usage. Across the data, federal holidays are correlated with higher visitation rates. As shown in Figure 13, there are, on average, 15 more cars present in the parking lots on federal holidays across both McAfee Knob and Dragon’s Tooth parking lots than on non-holidays.

Figure 13: Comparative Average Number of Cars in Lots on Federal Holidays vs. Non-Holidays



Source: Volpe Center analysis of Ridgerunner report data

Monday holidays in particular show high levels of parking lot usage in the available data. This is important to note for the transit feasibility study, as the high visitation rates on holidays will likely require service levels that may typically not be offered on a standard weekday.

The feasibility study timeframe included Labor Day 2020 (September 7, 2020). During the COVID-19 pandemic, NPS staff and project stakeholders observed extremely high visitation over the holiday weekend. The ranger on-site counted more than 80 hikers at McAfee Knob for sunrise on Saturday, September 5, 2020.⁹ Vehicles were parked in the McAfee Knob lot in such a way as to block many other cars from leaving (Figure 14), resulting in many being towed and hikers stranded. If a shuttle is found to be feasible, clear access to and from the stop at McAfee Knob will need to be maintained, which will require some form of parking management, such as formalized spaces or specific circulation directions.

⁹ Brian Wilson, APPA Visitor and Resource Protection Park Ranger. Biweekly project team check-in meeting on September 10, 2020.

Figure 14: McAfee Knob Parking Lot, Labor Day 2020



Source: National Park Service

Takeaways for the Transit Feasibility Study

- Because the existing parking lots are gravel, do not have marked parking areas, and present challenging geometry, navigating these lots in a larger transit vehicle is likely to be difficult. Design of possible shuttle service scenarios should account for these challenges and propose only feasible operational designs.
- Based on the data for typical busy days, it is clear that visitation is highest on weekends and holidays from April through July and then again in September and October. The parking lots fill up in mid-morning and remain full until early evening. Based on this data, it is likely that an efficient and effective shuttle system would focus on seasonal weekend service operating from mid-morning until early evening. However, this is preliminary consideration of existing conditions data. The next phase of the project involves shuttle service scenarios that also take into account desired visitation and visitor experiences. A shuttle service to mitigate parking area congestion should focus on seasonal weekend operations.



Visitation

Within the Triple Crown area, over 50,000 people visit McAfee Knob and 20,000-30,000 people visit Dragon's Tooth each year. Day hikers constitute about 85 percent of visitors and backpackers make up the remaining 15 percent. Backpackers are predominantly overnight visitors, staying one to two nights, except in May when there is a swell of through hikers in the region. Large groups, such as college and youth organizations, frequent McAfee Knob and nearby campsites. Users are primarily day hikers and many are from regional universities (such as Virginia Tech, Hollins, and Radford). Intense marketing of McAfee Knob by local businesses, travel companies, and social media influencers exacerbate this trend.¹⁰

Visitor Survey Information

RVARC conducted a survey of Triple Crown visitors in late 2019 via the internet and in-person at the trailheads and a local outdoor festival. The survey results showed that the vast majority of visitors are from within the region (80 percent of respondents lived within one hour of the trailheads). Of the visitors coming from more than one hour away, almost 70 percent were from Virginia. The survey also found that almost three-quarters of the respondents visit the trailheads often.

Infrared Counter Data

An infrared trail counter installed by the RVARC and maintained by the RATC is located along the A.T. near McAfee Knob. The counter records the number of people that pass it using an infrared sensor. Data are recorded in hourly increments.

In 2016-2017, there were anomalies in the infrared counter data, such as high counts (200+) between the hours of midnight and 6:00 AM, indicating counter malfunctioning or similar data collection errors. As a result, the project team excluded this data from its analysis and instead analyzed data from 2018 and 2019, which was free from high counts at late hours.¹¹

Similar to analysis of the Ridgerunner parking lot usage data, the project team narrowed its analysis to typical busy day times to which a potential shuttle service might be well-suited. Therefore, analyzed infrared counter data included data from Saturdays and Sundays between 7:00 AM to 8:00 PM. Each data point included in the analysis refers to a cumulative count of people passing the counter (traveling in either direction) over a one-hour period during this timeframe.

As shown in Figure 15, average infrared trail counts are higher on Saturdays than Sundays and peak at around 1:00 PM on both days, with an average of almost 60 people per hour on Saturdays and almost 40 people on Sundays. Visitation follows a similar trend on both days, rising starting at 7:00 AM consistently to 1:00 PM and then tapering off until 8:00 PM.

Notably, a comparison of the infrared counter data with Ridgerunner parking data show fewer people than expected represented in the infrared counter data. For example, the Ridgerunner data show average of 47 vehicles on Saturday and 40 vehicles on Sunday. Assuming each vehicle holds on average of two people per vehicle, the expected number of people on the trail should be double the number of vehicles,

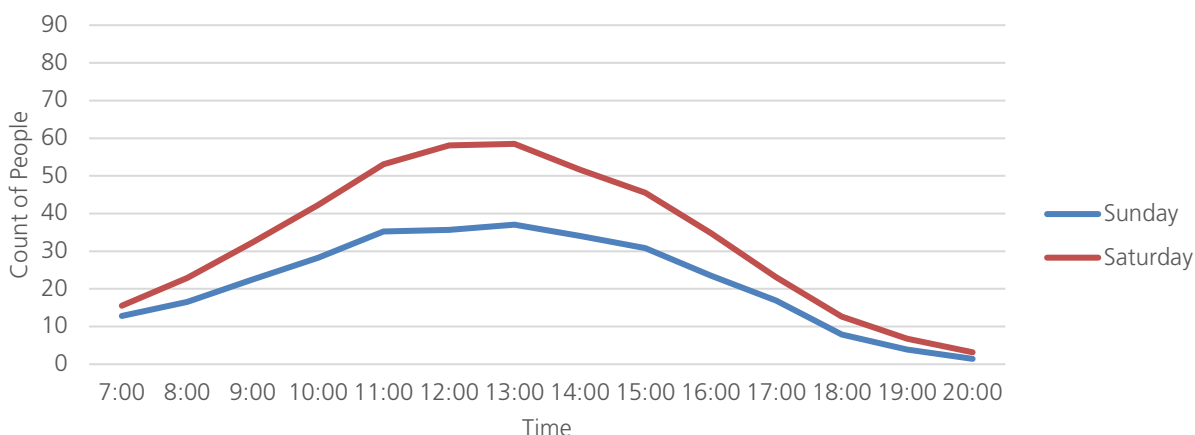
¹⁰ U.S. Department of Interior, National Park Service, *Appalachian National Scenic Trail, Preliminary Project Planning Completion Report*, 2020.

¹¹ Project stakeholders noted that sunrise and sunset are popular times for visits and require hikers to arrive as early as 3:00 AM; however, omitted data showed very high counts at all late hours, including midnight to 3:00 AM. Volumes were also higher than could be reasonably explained by early sunrise visitors.



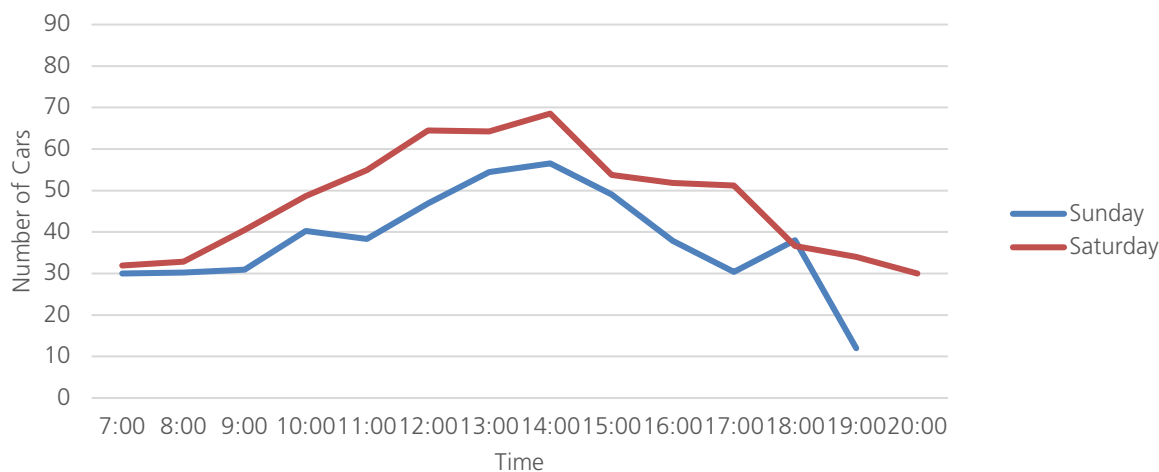
or 80 to 94 people on the trail. Instead, the infrared counter data indicate lower numbers. One possible explanation for this discrepancy is that the location of the counter along the trail may not capture all visitors, as some portion of those parking in the McAfee Knob lot may not pass by the counter. Another possible factor is that the Ridgerunner data do not account for length of stay, so cars parked overnight for multiple days could be counted multiple times in the data but backpackers would only pass the counter once or twice over a multi-day period. Figure 16 shows the average parking lot usage counts by time of day in the Ridgerunner data for comparison. Though less smooth than the infrared counter data (likely due to data limitations with the Ridgerunner data), the overall trendlines are somewhat similar between the two datasets.

Figure 15: Average Infrared Trail Counter Counts by Time of Day (2018-2019)



Source: Volpe Center analysis of infrared counter data

Figure 16: Average Ridgerunner Parking Lot Usage Counts by Time of Day (2017-2019)



Source: Volpe Center analysis of infrared counter data

Takeaways for the Transit Feasibility Study

- Because visitation is predominantly day hikers, any potential shuttle service will need to be tailored to meet the needs of these visitors and align with their hiking patterns.



- The vast majority of visitors are local and hike in the area often. Identifying bus stops convenient for visitors within the region can help draw them to the service; making the experience pleasant can help them become consistent riders. Local marketing and communications will be vital to attracting local hikers.
- The seasonality of visitation and heavy use on weekends (including Fridays) indicates that shuttle service may be limited to these days of week and times of year to keep operating cost low.

Conclusion

The Triple Crown trailheads of McAfee Knob, Dragon’s Tooth, and Tinker Cliffs draw tens of thousands of visitors annually. Visitation continues to rise, increasing demand for parking and creating roadway and parking lot congestion and safety issues. From 2017 to 2019, the McAfee Knob parking lot was documented to be at or over capacity nearly 10 percent of the time observations occurred. Dragon’s Tooth exceeded capacity about 6 percent of time observations occurred in the same period. **It is clear from the existing conditions data that the parking congestion at the Triple Crown trailheads at current visitation levels reduces the quality of the visitor experience, impacts staff resources (e.g., ticketing and towing errant vehicles), and creates safety issues.** The construction of the pedestrian bridge at the McAfee Knob trailhead provides a good opportunity to pilot shuttle service. The analysis presented here will be used to inform the development of potential shuttle service scenarios in the next phase of this transit feasibility study process.